

Dietary supplement intakes among adults living in Kota Kinabalu during the COVID-19 pandemic: A cross-sectional study

Fredrica Li Ling Vun, Yasmin Beng Houi Ooi & Ban-Hock Khor*

Nutrition Programme, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Sabah, Malaysia

ABSTRACT

Introduction: During the coronavirus 2019 (COVID-19) pandemic, the public may seek a non-pharmacological approach, such as dietary supplements, to prevent or manage COVID-19. Therefore, this study aimed to evaluate the use of dietary supplements during the COVID-19 pandemic among adults in Kota Kinabalu. **Methods:** This cross-sectional study recruited 213 adults living in Kota Kinabalu through convenient sampling from October 2021 to March 2022. A validated questionnaire was used to evaluate their perception on the use of dietary supplements, and the types of dietary supplements consumed before and during the COVID-19 pandemic. **Results:** One-hundred sixty-one (75.6%) adults reported that they were told to consume dietary supplements during the COVID-19 pandemic, primarily from close family members (64.0%) and social media (58.4%). One-hundred and thirty-two (62%) adults were consuming dietary supplements and 46 (34.8%) of them only started taking them during the COVID-19 pandemic. The reasons for taking dietary supplements during the COVID-19 pandemic included enhancing the immune system (83.6%) and for prevention of COVID-19 infection (64.4%). The most common dietary supplements consumed during the COVID-19 pandemic were vitamin C (90.2%), followed by multi-vitamin and mineral (32.6%), and fish oil (25.8%). After adjusting for age, sex, education level, and income level, Kadazan-Dusun adults were most likely to consume dietary supplements (adjusted odds ratio = 2.369, 95% CI: 1.070 - 5.248, $p=0.034$). **Conclusion:** There was an increase in the number of adults consuming dietary supplements during the COVID-19 pandemic, which was likely driven by information sharing via family members and social media.

Keywords: COVID-19, dietary supplement, minerals, vitamins

INTRODUCTION

The coronavirus disease 2019 (COVID-19) was caused by the novel severe acute respiratory syndrome coronavirus 2. It was first reported in China in late 2019 and then spread to other countries at an alarming speed. The World Health Organization (WHO) declared COVID-19 a global health

emergency on 30 January 2020 and the outbreak was declared a global pandemic on 11 March 2020 (Velavan & Meyer, 2020). In Malaysia, the first case of COVID-19 was reported on 25 January 2020. Since then, Malaysia was hit by a total of five waves of COVID-19 until this day. The first wave started on 25 January and lasted until 16

*Corresponding author: Khor Ban Hock, PhD

Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia

Tel: (6)018-6699066 E-mail: khorbanhock@gmail.com

doi: <https://doi.org/10.31246/mjn-2022-0096>

February 2020, involving only tourists from China. The second wave began on 27 February following a religious gathering and the wave lasted until 30 June 2020. The third wave of COVID-19 occurred on 8 September 2020 with a sudden surge of new cases due to the Benteng Lahad Datu cluster in Sabah and Tembok cluster in Kedah (Rampal & Liew, 2021). Although the cases began to decline by early March 2021, the spread of the Delta variant led to another surge of new cases starting in mid-April 2021 that peaked at the end of August 2021 with about 20,000 new cases reported daily. The fifth wave of COVID-19 in Malaysia was predominantly caused by the Omicron variant that reached its peak in February and March 2022 with about 30,000 new cases reported daily (Dong, Du & Gardner, 2020).

At the beginning of the COVID-19 pandemic, preventive measures, such as physical social distancing, wearing a face mask, and hand washing were recommended to reduce the risk of contracting the virus, and most Malaysians were reported to have complied with these necessary precautions (Azlan *et al.*, 2020). When COVID-19 vaccination became available, it became the primary tool used to reduce the incidence and severity of COVID-19; Malaysia has one of the highest COVID-19 vaccination rates globally as most Malaysians have been vaccinated against COVID-19 (COVIDNOW, 2022; Ng *et al.*, 2022). The manifestations of COVID-19 typically are fever, sore throat, fatigue, cough, and dyspnoea. The standard of care for individuals with COVID-19 includes supportive care measures such as hydration, oxygenation, and ventilation, while an antiviral therapy, namely Ritonavir-boosted Nirmatrelvir can be prescribed to selected patients (Gavriatopoulou *et al.*, 2021).

An optimal nutritional status is critical to support the immune system

to defend against pathogenic organisms including viruses. Although several studies have reported that malnutrition and micronutrient deficiencies were associated with increased severity of COVID-19 and lower survivability (Beigmohammadi *et al.*, 2021; Hemilä & De Man, 2021; Kurtz *et al.*, 2021; Rubin, 2021), there is insufficient data from well-designed randomised clinical trials to support the recommendations of using dietary supplements to prevent or treat COVID-19 (National Institute of Health, 2021). Nevertheless, there is a growing interest in consuming dietary supplements to enhance the immune function during the COVID-19 pandemic, although it is not substantiated by supporting evidence. Several studies conducted in Turkey (Altun, Ermumcu & Kurklu, 2021), Sri Lanka (Francis, Sooriyaarachchi & Jayawardena, 2022), Middle Eastern countries (Mukattash *et al.*, 2022), and Egypt (Khabour & Hassanein, 2021) have reported the usage of dietary supplements during the COVID-19 pandemic. Before the COVID-19 pandemic, the latest nationwide National Health and Morbidity Survey (NHMS) 2019 reported that 13.8% of Malaysian adults purchased dietary supplements in the past month (IPH, 2020). However, to the best of our knowledge, the usage of dietary supplements during the COVID-19 pandemic among the general population in Malaysia has not been previously reported. Therefore, the present study aimed to investigate the use of dietary supplements among adults in Kota Kinabalu, Sabah during the COVID-19 pandemic.

MATERIALS AND METHODS

Study design

A cross-sectional study using an online survey was conducted in Kota Kinabalu between October 2021 to March 2022 (24 weeks). Convenience sampling was

used to recruit respondents. The link to the online survey was distributed through social media such as Instagram and WhatsApp. The study followed the Declaration of Helsinki and the protocol was approved by the Medical Research Ethics Committee of Universiti Malaysia Sabah (UMS/FPSK6.9/100-6/1/95). The study background and aims, and scope of questions asked were all stated at the beginning of the online survey. Before respondents indicated their consent to continue with the online survey, they were provided with statements in Google Form that their participation was voluntary. Before commencing with the online survey, respondents were informed that all data collected would be used solely for research purposes, and their agreement for data sharing and publication was obtained.

Survey instrument

The questionnaire underwent content validation by five experts, including an internal medicine physician, a pharmacist, two nutritionists, and a dietitian; and the item-content validity index obtained was 1.0 for all questions. This questionnaire was pre-tested in a face-to-face pilot test using ten respondents who met the inclusion criteria to determine the readability and understandability of the questionnaire for laypersons. The time to complete the questionnaire was 10–15 minutes. The questionnaire was available in three languages, namely English, Malay, and Chinese. The questionnaire included three sections. The first section contained questions on sociodemography (age, sex, ethnicity, marital status, education background, and personal monthly income), height, weight, medical history, vaccination status, and COVID-19 status. The second section contained 16 questions concerning respondents' perception of dietary supplements and traditional

supplements, and their reasons for taking or not taking supplements. The third section covered the type of supplements taken, which were divided into three types of supplements (vitamin, mineral, and non-vitamin and -mineral). All questions were reported for two different periods: before and during the COVID-19 pandemic. The questionnaire was self-administered.

Sampling strategy and respondents

Eligible respondents were invited to participate in the survey through social media (Instagram and Whatsapp). The survey had to be conducted online due to the enforced COVID-19 pandemic lockdown restrictions and the inability to conduct face-to-face interviews. All respondents voluntarily participated in the study and were exposed to the study's aims and objectives before filling out the survey. The inclusion criteria were: (1) participants aged 20 years old and above; and (2) living in Kota Kinabalu. Participants were excluded if: (1) aged 19 years old and below; and (2) pregnant women. The sample size was calculated using the formula by Daniel (1999). Based on the expected prevalence of dietary supplement use at 47% during the second wave of COVID-19 as reported by Mukattash *et al.* (2022) and a precision of 5%, the calculated sample size was 195.

Statistical analysis

Data were analysed using SPSS software, version 26.0 (IBM SPSS Statistics Inc., Chicago, IL, USA). The prevalence of dietary supplement and traditional supplement use among the adults in Kota Kinabalu was analysed using descriptive analysis. Logistic regression was used to determine the associations of sociodemographic profiles with the intake of dietary supplements during the COVID-19 pandemic. Statistical significance was set at p -value < 0.05 .

RESULTS

Sociodemographic characteristics

A total of 213 adults participated in this study and their sociodemographic characteristics are shown in Table 1. The majority of the respondents were aged 20 – 29 years (55.9%), females (79.3%), Chinese (44.6%), single (62.4%), bachelor’s degree holders (67.1%), and had a personal monthly income of RM 2,500 and below (61.5%).

Table 1. Respondents’ sociodemographic characteristics (N=213)

| Characteristics | n (%) |
|------------------------------|------------|
| Age (years) | |
| 20 – 29 | 119 (55.9) |
| 30 – 39 | 33 (15.5) |
| 40 – 49 | 32 (15.0) |
| 50 – 59 | 24 (11.3) |
| 60 – 69 | 5 (2.3) |
| Sex | |
| Male | 44 (20.7) |
| Female | 169 (79.3) |
| Ethnic group | |
| Kadazan-Dusun | 68 (31.9) |
| Chinese | 95 (44.6) |
| Malay | 20 (9.4) |
| Others | 30 (14.1) |
| Marital status | |
| Single | 133 (62.4) |
| Married | 80 (37.6) |
| Education background | |
| Primary | 5 (2.3) |
| Secondary | 20 (9.4) |
| Pre-university | 12 (5.6) |
| Diploma | 27 (12.7) |
| Bachelor’s degree | 143 (67.1) |
| Master’s degree | 6 (2.8) |
| Personal monthly income (RM) | |
| 0 – 2500 | 131 (61.5) |
| 2501 – 5000 | 40 (18.8) |
| 5001 – 7500 | 28 (13.1) |
| ≥ 7501 | 14 (6.6) |

RM: Ringgit Malaysia

Dietary supplement intake patterns

Most of the respondents (n=161, 75.6%) reported that they had been told to take dietary supplements during the COVID-19 pandemic (Table 2). The sources of information were mainly their close family members (64.0%), social media (58.4%), and friends (42.9%). Almost everyone was told to consume vitamin C (95.7%), followed by multivitamins (34.8%) and omega-3 fatty acids (15.5%).

Table 2. Information on dietary supplement during COVID-19 pandemic

| Responses | n (%) |
|---|------------|
| Have been told to take dietary supplements during COVID-19 pandemic | |
| Yes | 161 (75.6) |
| No | 52 (24.4) |
| Sources of information on dietary supplements during COVID-19 pandemic [†] | |
| Close family members (i.e., parents and siblings) | 103 (64.0) |
| Social media | 94 (58.4) |
| Friends | 69 (42.9) |
| Mass media (i.e., newspaper, magazine, etc.) | 61 (37.9) |
| Relatives | 60 (37.3) |
| Healthcare professionals (i.e., doctors and nurses, etc.) | 37 (23.0) |
| Colleagues | 27 (16.8) |
| Retail pharmacy staff | 17 (10.6) |
| Type of dietary supplements told to consume during COVID-19 pandemic [†] | |
| Vitamin C | 154 (95.7) |
| Multivitamins | 56 (34.8) |
| Omega-3 fatty acids | 25 (15.5) |
| Vitamin D | 18 (11.2) |
| Zinc | 12 (7.5) |
| Others | 5 (3.1) |

[†]Only for respondents who answered “Yes” in the first question (n=161) and more than one option may be chosen

About two-thirds of the respondents ($n=132$, 62.0%) reported taking dietary supplements, and 46 (34.8%) of them only started taking dietary supplements during the COVID-19 pandemic (Table 3). Most of the respondents (84.1%) taking dietary supplements were aware that their choices of dietary supplements were registered with the Ministry of Health, Malaysia. The respondents mostly purchased their dietary supplements from retail pharmacies (69.7%), friends or relatives who were distributors or agents (33.3%), and online shopping platforms (29.5%).

The types of dietary supplements consumed by the respondents before and during the COVID-19 pandemic are

presented in Figure 1(a). Vitamin C was the most popular dietary supplement before ($n=78$, 59.1%) and during ($n=119$, 90.2%) COVID-19 pandemic, followed by multivitamin and multimineral (before COVID-19, $n=36$, 27.3%; after COVID-19, $n=43$, 32.6%), and fish oil (before COVID-19, $n=39$, 29.5%; after COVID-19, $n=34$, 25.8%). The frequency of consumption of all types of dietary supplements, except fish oil, had increased during the COVID-19 pandemic.

The reasons for the respondents to take and not take dietary supplements are shown in Figure 1(b). Strengthening the immune system was the most common reason (83.6%) for taking

Table 3. Patterns of dietary supplement intake during COVID-19 pandemic

| <i>Responses</i> | <i>n (%)</i> | <i>Median (IQR)</i> |
|--|--------------|---------------------|
| Currently taking dietary supplements | | |
| Yes | 132 (62.0) | |
| No | 81 (38.0) | |
| Timing of consumption of dietary supplements [†] | | |
| Before COVID-19 pandemic | 86 (65.2) | |
| During COVID-19 pandemic | 46 (34.8) | |
| Changes in dietary supplement intake patterns, during COVID-19 pandemic compared to before the pandemic [‡] | | |
| Type of dietary supplements increased | 20 (23.2) | |
| Amount/dosage of dietary supplements increased | 6 (7.0) | |
| Maintained the same intake of dietary supplements | 54 (62.8) | |
| Type of dietary supplements decreased | 2 (2.3) | |
| Amount/dosage of dietary supplements decreased | 4 (4.7) | |
| Aware that the dietary supplements consumed were registered with Ministry of Health [†] | | |
| Yes | 111 (84.1) | |
| No | 21 (15.9) | |
| Sources of dietary supplements ^{†,§} | | |
| Retail pharmacy | 92 (69.7) | |
| Chinese traditional medicine store | 12 (9.1) | |
| Clinic or hospital | 15 (11.4) | |
| Online shopping platform | 39 (29.5) | |
| Friends or relatives who were distributors or agents | 44 (33.3) | |
| Monthly expenses on dietary supplements (RM) [†] | | 50 (150) |

IQR: interquartile range; RM: Ringgit Malaysia

[†]Respondents who were taking dietary supplements ($n=132$)

[‡]Respondents who consumed dietary supplements before COVID-19 pandemic ($n=86$)

[§]More than one option may be chosen

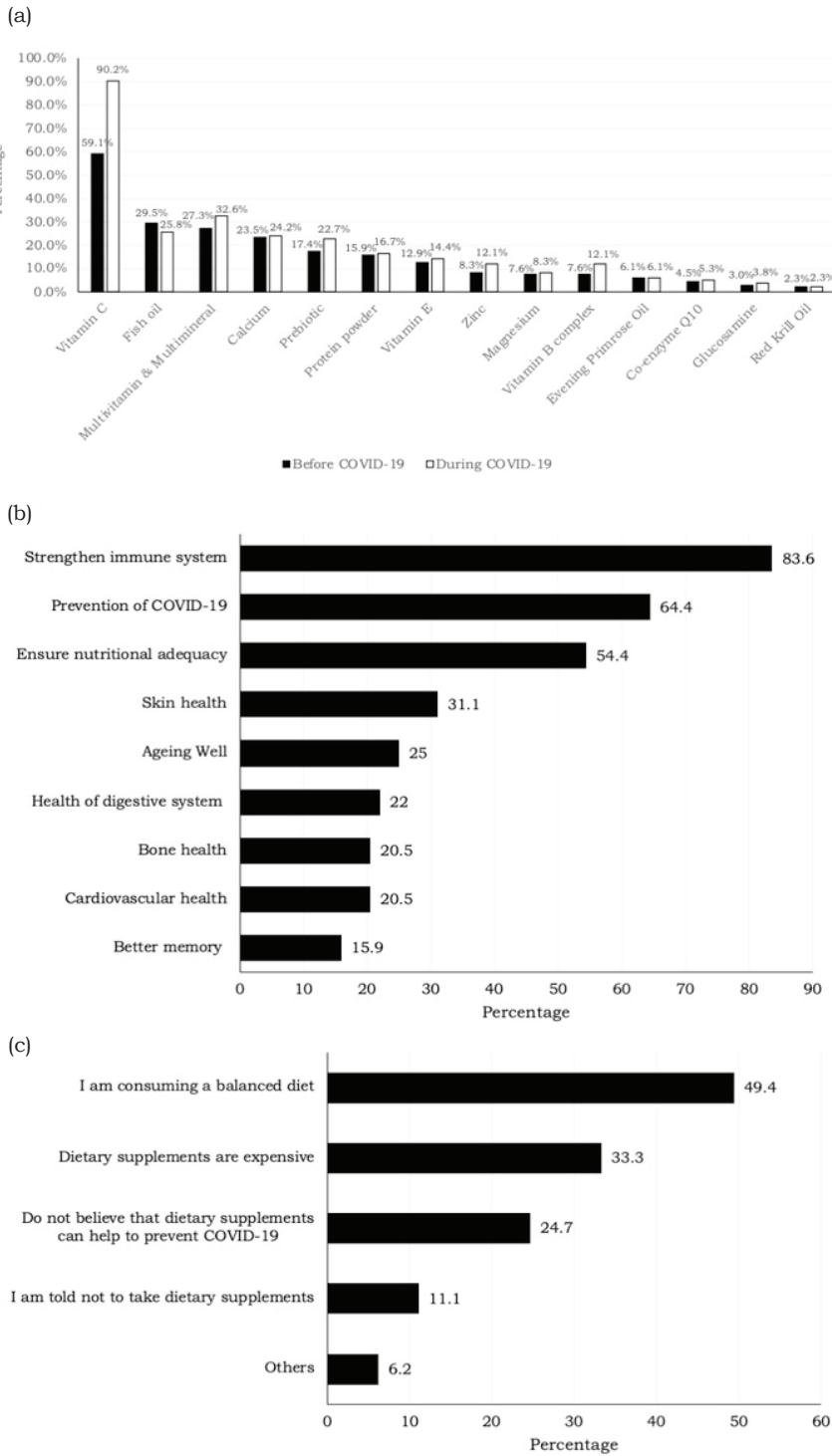


Figure 1. Patterns of dietary supplement intakes: (a) types of supplements; (b) reasons for taking; and (c) reasons for not taking

dietary supplements, followed by prevention of COVID-19 (64.4%) and ensuring nutritional adequacy (54.5%). Most respondents who did not take dietary supplements reported that they believed they were consuming a balanced diet (49.4%), dietary supplements were expensive (33.3%), and did not believe that dietary supplements could help to prevent COVID-19 (24.7%), as presented in Figure 1(c).

Sociodemographic factors and dietary supplement intakes

The associations between sociodemographic factors and dietary supplement intake are presented in Table 4. Simple logistic regression showed that the age

group of 30–39 years ($OR=0.324$, 95% CI : 0.129, 0.815, $p=0.017$) or being married ($OR=0.408$, 95% CI : 0.223, 0.745, $p=0.004$) were less likely to take dietary supplements, while Kadazan-Dusuns ($OR=2.661$, 95% CI : 1.251, 5.662, $p=0.011$) or Chinese ($OR=2.391$, 95% CI : 1.187, 4.816, $p=0.015$) were more likely to take dietary supplements. Further analysis using multiple logistic regression found that only the Kadazan-Dusun ethnic group was 2.4 times more likely to take dietary supplements than other ethnic groups (adjusted $OR=2.369$, 95% CI : 1.070, 5.248, $p=0.034$). No other factors were significantly associated with dietary supplement intake.

Table 4. Associations between sociodemographic factors and dietary supplement intake

| Variables | Simple logistic regression | | Multiple logistic regression | |
|------------------------------|----------------------------|---------|------------------------------|---------|
| | OR (95%CI) | p-value | adj. OR (95%CI) | p-value |
| Age (years) | | | | |
| 20 – 29 | 1.00 (reference) | | 1.00 (reference) | |
| 30 – 39 | 0.324 (0.129, 0.815) | 0.017* | 1.670 (0.378, 7.367) | 0.498 |
| 40 – 49 | 0.636 (0.208, 1.944) | 0.428 | 4.240 (0.897, 20.05) | 0.068 |
| 50 – 59 | 1.379 (0.403, 4.714) | 0.609 | 3.576 (0.686, 18.64) | |
| Sex | | | | |
| Female | 1.00 (reference) | | 1.00 (reference) | |
| Male | 0.713 (0.365, 1.394) | 0.323 | 0.664 (0.314, 1.406) | 0.285 |
| Marital status | | | | |
| Single | 1.00 (reference) | | 1.00 (reference) | |
| Married | 0.408 (0.223, 0.745) | 0.004* | 0.889 (0.262, 3.019) | 0.850 |
| Education background | | | | |
| Diploma and below | 1.202 (0.655, 2.204) | 0.553 | 0.734 (0.339, 1.592) | 0.434 |
| Bachelor's degree and above | 1.00 (reference) | | 1.00 (reference) | |
| Ethnic group | | | | |
| Kadazan-Dusun | 2.661 (1.251, 5.662) | 0.011* | 2.369 (1.070, 5.248) | 0.034* |
| Chinese | 2.391 (1.187, 4.816) | 0.015* | 1.628 (0.758, 3.498) | 0.212 |
| Others | 1.00 (reference) | | 1.00 (reference) | |
| Personal monthly income (RM) | | | | |
| ≤ 2500 | 1.00 (reference) | | 1.00 (reference) | |
| 2501–5000 | 0.514 (0.246, 1.077) | 0.078 | 1.793 (0.678, 4.738) | 0.239 |
| > 5000 | 1.544 (0.574, 4.153) | 0.389 | 0.935 (0.290, 3.010) | 0.910 |

adj: adjusted; CI: confidence interval; OR: odds ratio; RM: Ringgit Malaysia

* $p<0.05$

DISCUSSION

In the present study, we found that there was an increase in dietary supplement intakes during the COVID-19 pandemic, particularly dietary supplements with immunomodulating effects such as vitamin C, zinc, vitamin Bs, and probiotics. One-third of the adults consuming dietary supplements only started taking them during the COVID-19 pandemic. Interestingly, we found that the number of adults consuming fish oil supplements had reduced during the COVID-19 pandemic, while other dietary supplements showed an increasing trend. Although it was expected that dietary supplement intakes would increase during the COVID-19 pandemic, this study provides facts and figures on the dietary supplement consumption patterns among adults living in Kota Kinabalu, which is generally understudied.

Several studies have examined the intake of dietary supplements among Malaysians before the COVID-19 pandemic. The Malaysian Adult Nutrition Survey 2014 is a nationwide survey, and it was found that 28.1% of adults consumed vitamin and mineral supplements such as vitamin C and multivitamin/multimineral, while 34% of adults consumed food supplements such as fish oil, royal jelly, and spirulina (Zaki *et al.*, 2018). The NHMS 2019 reported that 13.8% of Malaysian adults purchased dietary supplements in the last one month before the interview, while the prevalence for adults in Sabah was 10.1% (IPH, 2020). Another study reported that 55.4% of government employees in Putrajaya consumed dietary supplements (Mohd Asri, Abu Saad & Adznam, 2021). In the present study, we observed a higher prevalence (40.4%) of adults consuming dietary supplements before the COVID-19 pandemic than the one reported by NHMS 2019 for Sabah.

There are several possible explanations for this discrepancy. Firstly, the current study was conducted in Kota Kinabalu instead of the whole state of Sabah, and the use of dietary supplements is known to be higher in urban compared to rural areas. Secondly, the NHMS 2019 assessed the purchase of dietary supplements in the past month instead of the habit of consuming dietary supplements.

In the present study, 62% of adults in Kota Kinabalu reported that they consumed dietary supplements during the COVID-19 pandemic and this finding seems to be consistent with an earlier study that reported a prevalence of 55.3% in dietary supplement usage among healthcare workers in Pulau Pinang, Malaysia during the COVID-19 pandemic (Lee *et al.*, 2021). Consistent with our findings, Lee and colleagues (2021) also reported that vitamin C was the most common dietary supplement consumed by the participants. Similarly, a multinational survey conducted in Middle Eastern countries, including Lebanon, Saudi Arabia, Palestine, Jordan, and the United Arab Emirates, reported that 46.6% of participants consumed dietary supplements for the prevention of COVID-19, and the most common dietary supplements used were vitamin C, vitamin D, and zinc (Mukattash *et al.*, 2022). On the contrary, other studies reported a much lower prevalence of dietary supplement use during the COVID-19 pandemic. Khabour & Hassanein (2021) observed that the percentages of dietary supplement users among Egyptian adults for vitamins C, D, A, and Bs were 27%, 17%, 13%, and 13%, respectively. Another study conducted in Sri Lanka found that only 25.5% of participants took dietary supplements regularly, while 32.6%, 14.5%, and 27.4% of participants occasionally, rarely, and never took dietary supplements,

respectively. Similarly, vitamin C was the most consumed dietary supplement in this population as well (Francis *et al.*, 2022). Our current findings and findings by these other researchers showed that vitamin C was the most common dietary supplement consumed during the COVID-19 pandemic.

Although the consumption of vitamin C has no effect on the prevention of common cold, it has a modest effect in reducing the duration of common cold symptoms (Hemilä & Chalker, 2013). Despite a low level of vitamin C being a risk factor for COVID-19 mortality (Arvinte, Singh & Marik, 2020), there is insufficient evidence from well-designed randomised controlled trials to support the use of vitamin C supplements for the treatment of COVID-19 (Rawat *et al.*, 2021). In fact, one randomised controlled trial demonstrated that COVID-19 patients receiving vitamin C and zinc supplements did not have a reduced duration of symptoms, instead they experienced more side effects such as diarrhoea, stomach cramp/pain, and nausea (Thomas *et al.*, 2021). A prospective cohort study showed that supplemental vitamin C intakes were significantly associated with the risk of kidney stones among men, but not women (Ferraro *et al.*, 2016). Therefore, it is critical for healthcare workers to disseminate the correct information on dietary supplements to the public, particularly on the potential health risks from megadoses.

In the present study, only 23% of the participants claimed that they had received information on dietary supplements from healthcare workers, while family members and social media were their primary sources of information. These findings corroborate the results of studies conducted in Middle Eastern countries that the consumption of dietary supplements was mainly influenced by lay information sources

promoted on social media (Mukattash *et al.*, 2022). Nowadays, social media are used for other purposes beyond social interaction, such as advertising, marketing, business solutions, education, and knowledge dissemination. However, the overall quality of content on social media regarding nutrition information was found to be extremely low (Kabata *et al.*, 2022). This could lead to misleading nutrition information being disseminated, and potential toxicity and adverse effects of dietary supplements not being conveyed to the public.

Our study had several strengths and limitations. Firstly, to the best of our knowledge, this was the first study to assess the intake of dietary supplements among the general public in Malaysia during the COVID-19 pandemic. Secondly, a questionnaire validated by five experts was used in this study. However, this study is limited by its external generalisation to other areas in Malaysia, because it was conducted in Kota Kinabalu, which has a unique sociodemographic profile such as the mosaic of ethnic groups that are not found in Peninsular Malaysia. The sample size was relatively small as compared to other online surveys, albeit having met the calculated number. In addition, respondents recruited for this study were generally young as this study was carried out online to comply with the standard operating procedures during the COVID-19 pandemic. Older people are generally less likely to be active and/or competent users of online platforms. Another limitation of this study was more female respondents were recruited and health-seeking behaviours, such as consuming dietary supplements, could vary between men and women. We also did not collect information on the dosage of dietary supplements consumed by the respondents. Despite these limitations, this study still provided new insights into the patterns of dietary supplement

intake among Malaysians during the COVID-19 pandemic.

CONCLUSION

The present study found that more than half of the adults living in Kota Kinabalu took at least one dietary supplement, and one-third of them only started taking dietary supplements during the COVID-19 pandemic. The majority of the adults were told to take dietary supplements and this information was mainly from their family members and social media. Most adults taking dietary supplements believed that this practice could strengthen the immune function and prevent COVID-19 infection, despite there being no evidence to support such claims. These findings highlighted the important role of nutrition professionals in conveying the correct information related to dietary supplements to the public. In addition, it is important for healthcare professionals in clinical practice to assess the intake of dietary supplements during the COVID-19 pandemic, as some dietary supplements will have interactions with medications and could cause harmful effects if consumed excessively.

Acknowledgement

We would like to thank the five experts for the content validation and ten respondents for the pre-testing of the questionnaire used in this study. We would also like to thank all respondents for their time in participating in this study. This study was self-funded.

Authors' contributions

Vun FLL, conducted the study, led the data collection, performed data analysis, and wrote the original draft; Ooi YBH, conceptualised the study, validated the methods, and reviewed and edited the draft; Khor BH, conceptualised the study, performed data analysis, and wrote the original draft.

Conflict of interest

The authors declare that there is no conflict of interest.

References

- Altun HK, Ermumcu MSK & Kurklu NS (2021). Evaluation of dietary supplement, functional food and herbal medicine use by dietitians during the COVID-19 pandemic. *Public Health Nutr* 24(5):861-869.
- Arvinte C, Singh M & Marik PE (2020). Serum levels of vitamin C and vitamin D in a cohort of critically ill COVID-19 patients of a North American community hospital intensive care unit in May 2020: a pilot study. *Med Drug Discov* 8:100064
- Azlan AA, Hamzah MR, Sern TJ, Ayub SH & Mohamad E (2020). Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One* 15(5):e0233668.
- Beigmohammadi MT, Bitarafan S, Abdollahi A, Amoozadeh L, Salahshour F, Soltani D & Motallebnejad ZA (2021). The association between serum levels of micronutrients and the severity of disease in patients with COVID-19. *Nutrition* 91:111400.
- COVIDNOW (2022). In: Vaccinations in Malaysia. Last updated 18 Aug 2022, 2:02 am. From: <https://covidnow.moh.gov.my/vaccinations/> [Retrieved August 18 2022].
- Daniel WW (1999). *Biostatistics: A foundation for analysis in the health sciences*. 7th Ed. John Wiley & Sons, New York.
- Dong E, Du H & Gardner L (2020). An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 20(5):533-534.
- Ferraro PM, Curhan GC, Gambaro G & Taylor EN (2016). Total, dietary, and supplemental vitamin C intake and risk of incident kidney stones. *Am J Kidney Dis* 67(3):400-407.
- Francis TV, Sooriyaarachchi P & Jayawardena R (2022). Usage of nutritional supplements to improve immunity during the COVID-19 pandemic: An online survey. *Clin Nutr Open Sci* 43:6-19.
- Gavriatopoulou M, Ntanasis-Stathopoulos I, Korompoki E, Fotiou D, Migkou M, Tzanninis IG, Psaltopoulou T, Kastritis E, Terpos E & Dimopoulos MA (2021). Emerging treatment strategies for COVID-19 infection. *Clin Exp Med* 21(2):167-179.
- Hemilä H & Chalker E (2013). Vitamin C for preventing and treating the common cold. *Cochrane Database Syst Rev* 2013(1):CD000980
- Hemilä H & De Man AM (2021). Vitamin C and COVID-19. *Front Med* 7:559811

- IPH (2020). *National Health and Morbidity Survey (NHMS) 2019: Vol. II: Health Care Demand*. Institute for Public Health (IPH), National Institutes of Health, Ministry of Health Malaysia.
- Kabaa P, Winniczuk-Kabata D, Kabata PM, Jaśkiewicz J & Polom K (2022). Can Social Media Profiles Be a Reliable Source of Information on Nutrition and Dietetics? *Healthcare* 10(2):397.
- Khabour OF & Hassanein SF (2021). Use of vitamin/zinc supplements, medicinal plants, and immune boosting drinks during COVID-19 pandemic: A pilot study from Benha city, Egypt. *Heliyon* 7(3):e06538.
- Kurtz A, Grant K, Marano R, Arrieta A, Feaster W, Steele C & Ehwerhemuepha L (2021). Long-term effects of malnutrition on severity of COVID-19. *Sci Rep* 11(1):1-8.
- Lee HT, Loh HC, Ramlee SNL & Looi I (2021). Oral dietary supplements use among healthcare workers during the COVID-19 pandemic in Malaysia. *Prog Microbes Mol Bio* 4(1):a0000236.
- Mohd Ashri MH, Abu Saad H & Adznam SNA (2021). Socio-Demographic Characteristics, Body Weight Status and Energy Intake among Users and Non-Users of Dietary Supplements among Government Employees in Putrajaya, Malaysia. *Nutrients* 13(7):2248.
- Mukattash TL, Alkhalidy H, Alzu'bi B, Abu-Farha R, Itani R, Karout S, Khojah HM, Khdour M, El-Dahiyat F & Jarab A (2022). Dietary supplements intake during the second wave of COVID-19 pandemic: a multinational middle eastern study. *Eur J Integr Med* 49:102102.
- National Institute of Health (2021). *In: Dietary Supplements in the Time of COVID-19: Fact Sheet for Health Professionals*. From: <https://ods.od.nih.gov/factsheets/COVID19-HealthProfessional/> [Retrieved 20 July 2022].
- Ng JWJ, Vaithilingam S, Nair M, Hwang LA & Musa KI (2022). Key predictors of COVID-19 vaccine hesitancy in Malaysia: An integrated framework. *PLoS One* 17(5):e0268926.
- Rampal L & Liew BS (2021). Malaysia's third COVID-19 wave-a paradigm shift required. *Med J Malaysia* 76(1):1-4.
- Rawat D, Roy A, Maitra S, Gulati A, Khanna P & Baidya DK (2021). Vitamin C and COVID-19 treatment: A systematic review and meta-analysis of randomized controlled trials. *Diabetes Metab Syndr* 15(6):102324.
- Rubin, R. (2021). Sorting out whether vitamin D deficiency raises COVID-19 risk. *JAMA* 325(4):329-330.
- Thomas S, Patel D, Bittel B, Wolski K, Wang Q, Kumar A, Il'Giovine ZJ, Mehra R, McWilliams C, Nissen SE & Desai MY (2021). Effect of high-dose zinc and ascorbic acid supplementation vs usual care on symptom length and reduction among ambulatory patients with SARS-CoV-2 infection: the COVID A to Z randomized clinical trial. *JAMA Netw Open* 4(2):e210369.
- Velavan TP & Meyer CG (2020). The COVID-19 epidemic. *Trop Med Int Health* 25(3):278-280.
- Zaki NM, Rasidi MN, Awaluddin SM, Hiong TG, Ismail H & Nor NM (2018). Prevalence and characteristic of dietary supplement users in Malaysia: data from the Malaysian Adult Nutrition Survey (MANS) 2014. *Glob J Health Sci* 10(12):127-135.